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HERBS FOR COMBATTING DERMATOPHYTOSIS-A REVIEW

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ABSTRACT: Infinite varieties of plants- both medicinal and aromatic are seen on the Indian continent. Siddha system of medicine is effectively making use of them. Sage Yugi have classified skin diseases into 18 kuttas. Pundareega kuttam is one among them. It can be correlated to dermatophytosis in modern science. Siddhars, scientists of a sort have found a remedy to the newly emerging mysterious diseases during their lifetime in the remote past. A thorough literature survey brings them to the limelight. Medicinal plants with antimicrobial activity are found widely in Siddha literature. Many effective compound formulations are also available to treat dermatophytosis. This article focuses on the herbs having *in-vitro* anti-dermatophytic activity and medicinal plants in Siddha literature for treating dermatophytosis. This preliminary literature search will help to understand the potential for further research in this area.

INTRODUCTION: Fungal skin infections can be classified into superficial mycosis and deep mycosis. In superficial mycosis, the infection is restricted to stratum corneum while deeper layers are infected in deep mycosis. Mainly immune compromised patients are victims of deep mycosis. Dermatophytosis also called as tinea or ringworm is an infection caused by a group of keratinophilic fungi called dermatophytes. The three major genera causing tinea are *Trichophyton, Microsporum* and *Epidermophyton* [1, 2]. Dermatophytes colonize the skin, nails, and hair of the human population. It affects the keratinous tissues of humans and other vertebrates and thus causes superficial infections [3].

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Utilization of the plants as antimicrobials in the cure of infectious diseases is not a new concept. It is in vogue from the ancient times. Herbal medicines have minimal side effects when compared to synthetic drugs. The alarming increase in dermatophyte infection, drug resistance, frequent remissions and relapses and the hepatotoxicity caused by some oral synthetic antifungal agents are the matter of deep concern.

In Siddha system of medicine, the term kuttam denotes various skin diseases. Sage yugi has classified kuttam into 18 types, and padarthamarai kuttam (Pundareega kuttam) is one among them. This padarthamarai kuttam can be correlated to dermatophytosis in modern science. It is a variety in which the patches are pale red in the center and dark red on the edges resembling the petals of the lotus. Padarthamarai kuttam can be correlated to dermatophytoses. This article is focussed on herbal remedies for tinea infection. The herbs mentioned in Siddha literature for Padarthamarai, Padai, *etc*.,

the results of herbs whose *in-vitro* anti-dermatophytic activity was scientifically validated is also mentioned.

Literature Survey: [4] The below-mentioned herbs in **Table 1** are potent antimicrobial and antifungal agents as per Siddha literature.

TABLE 1: HERBS FOR FUNGAL INFECTIONS

Botanical name	Vernacular name	Part used
Azadirachta indica	Neem tree, margosa tree	Leaf, unripe fruit, oil, bark
Allium sativum	Garlic	Bulb
Indigofera tinctoria	Indian indigo plant	Leaf, root
Alangium salvifolium	Sage left alangioma	Bark, seeds
Cynodon dactylon	Bermuda grass, bhama grass	Root, grass
Corallocarpus epigaeus	Bryons	Root, tuber
Aristolochia bracteolata	Worm killer, Indian birthwort	Whole plant
Cassia alata	Ring worm shrub	Leaf, root, flower
Curcuma longa	Turmeric	Rhizome
Ferula asafoetida	Asafoetida	Gum
Thespesia populnea	The portla tree (heartwood)	All parts
Calophyllum inophyllum	Alexandria laurel	Flower, leaf, oil, seed, bark
Tamarindus indica	Tamarind tree	Leaf
Pongamia pinnata	Indian beech	Seed, oil, root, flower
Sterculia foetida	Poon tree, pinery	Seed, bark
Aquilaria agallocha	Aloe wood, eaglewood	Wood, resin
Nerium odorum	The oleander	Root bark, flower
Smilax china	China root	Root tuber
Butea monosperma	Flame of the forest	Seed
Artocarpus heterophyllus	Jack fruit tree	Leaf
Momordica charantia	Bitter gourd	Fruit, leaf
Lawsonia inermis	Henna plant	Leaf
Pistia stratiotes	The water lettuce	Leaf
Mirabilis jalapa	Four o ‘clock flower	Leaf
Lepidium sativum	Garden cress	Seeds
Clerodendum inerme	Smooth volkameria	Leaf
Euphorbia ligularia	Common milk hedge	Leaf
Datura mete	Datura (white flowering) , thorn apple	Leaf
Strychnos nux vomica	Strychnine tree	Fruit, seed
Calotropis gigantea	Gigantic swallow-wort	Root. bark
Jatropha curcas	Purging nut	Oil
Sesamum indicum	Gingely oil	Seed oil
Alstonia scholaris	Devil tree, shaitan wood	Root
Carum copticum	The bishop weed	Seed
Terminalia chebula	Chebulic myrobalan	Fruit
Curcuma aromatica	Cochin turmeric	Rhizome
Mallotus philippinensis	Monkeyface tree	Powder on fruit
Spaeranthus indicus	East Indian globe thistle	Leaf
Eclipta prostata	Trailing eclipta	Whole plant
Gloriosa superba	Superb lily, Malabar glory lily	Rhizome
Euphorbia aniquoram	Quadrangular spurge	Milk
Jatropha curcas	English physic nut	Leaf, seed
Madhuca indica	Butter trees	Bark, seed
Cassia absus	Horse gram (black)	Leaf, seed
Albizzia lebbeck	Sirissa tree	Flower
Psoralea corylifolia	Bakuchi seeds	Seeds
Crotalaria retusa	Rattle wort	Leaf
Portulaca oleracea	Common indian parselane	Leaf, seed
Oxalis corniculata	The Indian sorrel	Leaf
Phyllanthus amarus	Indian Phyllanthus	Whole plant
Holarrhena pubescens	The kurchi	Bark, seed
Majorana hortensis	Southernwood	Whole plant
Pterocarpus marsupium	The Indian kino tree	Leaf
Allium cepa	Onion	Bulb

Prunus dulcis	Almond	Nut
Centella asiatica	Indian pennywort	Whole plant
Paspalum scrobiculatum	Kode millet	Straw, rice
Bambusa arundinaceae	Bamboo	Root
Boerhavifusa diffusa	Hogweed, pigweed	Root
Moringa oleifera	Drum stick tree	Bark
Piper nigrum	Black pepper	Seed
Ammania baccifera	Blistering ammania	Leaf
Desmotachya bipinnata	Salt reed- grass	leaves
Clerodendrum phlomoidis	Wind killer	Leaf
Piper longum	Long pepper	Unripe fruit
Cocos nucifera	Coconut tree	Oil from fruit
Heliotropium Indicum	Heliotrope, Indian turnsole	Leaf, flower
Cordia dichotoma	Fragrant manjack	Bark, fruit
Gossypium arboreum	Tree cotton	Seeds, root, bark
Argemone mexicana	Mexican poppy	Seeds, seed oil
Boswellia serrata	Salai	Gum resin
Acalypha indica	Indian nettle	Leaf
Plumbago zeylanica	Ceylon leadwort or doctor bush	Root, bark
Cassia fistula	Golden shower tree	Bark
Rungia repens	Creeping rungia	Leaves
Cyperus rotundus	Nutgrass	Root tuber
Coccinia grandis	Ivy gourd	Leaf
Trianthema decandra	Spreading hogweeds	Leaf, root
Santalum album	Sandalwood	Oil, wood
Indigofera aspalanthides	Black henna, commercial indigo	Leaf, flower, root
Tinospora cordifolia	Guduchi	Stems, root, leaf
Nigella sativa	Black cumin	Seeds
Vernonia anthelmintic	Wormseed	Seeds
Semecarpus anacardium	Marking nut tree	Fruit
Cassia tora	Fetid cassia	Seed, leaf, root
Acorus calamus	Sweet flag	Rhizome
Cassia senna	Country senna, tinnellvelly senna	Leaf

Herbs with Scientific Validation: Nowadays, study on dermatophyte infections has assumed greater importance because of the significant increase in statistics of patients with HIV AIDS, diabetes mellitus, cancer and organ transplantation [5]. In this context, Computerised literature search was done. Search was through google search engine, Pub Med, Willey online library, and Cochrane library till date. Primary search terminologies used were *in-vitro* antidermatophytic activity, herbs or medicinal plants. Search was preceded further by mentioning the botanical names of the plants in Siddha literature.

The herbs so far tested for their action against dermatophytes and their results are discussed below. The aqueous extracts of *Pergularia tomentosa* and *Mitracarpus scaber* at the concentration of 10, 20, 40, 80 and 160 mg/ml were active on *trichophytom mentagrophytes* and *trichophyton rubrum*. These plants showed activity against *microsporum audouini* and *microsporum gypseum* only at the concentration of 80mg/ml and 160 mg/ml. The chloroform and hexane extract of *Pergularia tomentosa* showed activity against *T. rubrum, T. mentagrophytes, M. gypseum* at low concentration of 10 mg/ml. A negative result is also reported by the author. The aqueous extract of *Stereospermum kunthianum* and *Euphorbia balsamifera* at the concentration of 10, 20, 40, 80,160 mg/ml is not effective against any of the dermatophytes tested.

Further, studies can be carried out at higher concentrations [6]. Hee Youn Chee had conducted a study to investigate the antidermatophytic activity of clove essential oil and its volatile vapour. The study result showed that the volatile vapour of clove essential oil was strongly active to *T. rubrum* and *T. mentagrophytes*. The spore germination of the above two organisms were completely inhibited by the volatile vapour of clove essential oil. It also strongly inhibits the mycelial growth of *Epidermophyton floccossum* and *Microsporum*

audiouinii. The MIC of clove oil was 1% for *T. rubrum* and *T. mentagrophytes*, 5% and 2.5% (in brith assay) for *E. floccose* and *M. audiouinii*. It is inferred from the study that clove oil possesses fungicidal activity and its vapour has fungistatic activity [7]. A research study reveals that water and etanolic extracts of leaves of *Azadirachta indica, Jatropha curcas, Jatropha gossypifolia, Cassia alata, Aloe vera,* and *Anacardium occidentale* were assessed *in-vitro* for their efficacy in treating ringworm infections. At the concentration of 2mg/l, 5 mg/l the aqueous extract of *aloe vera* was found to be effective against *T. mentagrophytes* and *T. rubrum*.

Cassia alata at the concentration of 5 mgl^{-1} was active against *T. mentagrophytes* and at 2 mgl^{-1} active against *T. rubrum. Jatropha gossypifolia's* aqueous extract was effective against *T. rubrum* at 2 mgl^{-1} itself. The ethanolic extract of leaves of *Aloe vera, Anacardium occidentale, Azadirachta indica, Jatropha curcas, Jatropha gossypifolia* showed very high activity against *T. mentagrophytes* and *T. rubrum* at the concentration of 2, 5, 10 mgl^{-1}. This is evident from the above that ethanol can extract the phytochemicals effectively [8].

Nadkarni in the year 1956 itself has mentioned the use of Neem and *Pongamia pinnata* in the treatment for ringworm. *T. mentagrophytes* was found to be susceptible to *Ocimum sanctum* leaves, *Cassia tora* leaves, *Cassia occidentalis*, resins of *Shorea robusta*, seeds of *Mucuna pruriens*, the fruit of *Ficus oppositifolia* and stem of *Curcuma longa*. 10mg/ml is found to be the MIC of ether extract of resins of *Shorea robusta* and the same for chloroform extract of *Moringa pterigosperma* and stem of *Curcuma longa* [9]. Limonene pepeljnak e*t al*., 2005; sonboli *et al*., 2006, a naturally occurring monoterpene detected in the essential oils of several plants is a very good fungicidal agent. It is active against *T. rubrum* at a concentration of 0.5% v/v [10].

In a research work carried on with the leaf extracts and stem barks of *Xylosma longifolium*, it is found that the herb exhibited moderate, moderate antidermatophytic activity against *M. canis M. gypseum* by petroleum ether extract. The chloroform and methanol extract also showed activity against, and *T. ajelloi* [11] Inouyes *et al*., has carried out a screening assay of 72 essential oils against *T. mentagrophtes*. The most active essential oils were *Origanum vulgare, Thymus serpyllum, Eugenia caryophyllum, Cymbopogon nardus, Pelargonium roseum, Lindera umbellata, Aniba rosaeodora, Thymus vulgaris, Lavandula latifolia, L. angustifolia, Maleleuca alternifolia* [12], [13]. In a study on cinnamomum oil the author correlated the antifungal activity with its chemical constituents. The toxicity against dermatophytes are due to the high level of cinnamaldehyde (44.2%) eugenol (90.2%) present in *Cinnamomum zeylanicum*. The increased amount of benzyl benzoate? (>50%) in leaf oil of *C. rhynchophyllum, C. microphyllum, C. pubescens, C. impressicostatum* & *C. mollissimum* is responsible for selective toxicity against dermatophytes [14].

An *in-vitro* and *in-vivo* study was carried out to find the antidermatophytic activity of *Polyscias fulva*. The crude extract of stem bark powder of the plant and hexane, ethyl acetate fraction, *n*-butanol fraction and residue fractions were tested against 8 dermatophyte species. Except for hexane fraction, the others exhibited more than 20 mm zone of inhibition. The MIC of crude extract was 0.5-1. The study that the extract oil formulation at 5% mats is useful in treating tinea infections [15]. In a study on *Azadirachta indica*, it was observed that the neem seed extract was most effective against all organisms tested with MIC and MFC of 31.25 µg/ml. Ethyl acetate extract of neem leaf was effective against *T. violaceum* and *E. floccossum*. Ethanolic extracts showed activity against *T. rubrum* and *M. nanum* with 250µg/ml as MIC [16]. Venugopal and Venugopal in 1994 worked on 88 clinical isolates of dermatophytes. He tried out the antidermatitic activity with ethanolic and aqueous extracts of neem leaves.

10 mg/ml ethanolic extract of *Achyanthes aspera* showed 23 mm zone of inhibition and 19 mm in aqueous extract against *T. rubrum* [17]. There is a mention in most of the Siddha literature that *Ocimum sanctum* is excellent for respiratory ailments. But the herb's antidermatophytic activity was scientifically validated by Balakumar S *et al*., in 1995. Aqueous, alcoholic, hexane, benzene, chloroform, ethyl acetate, methanol fraction and water fraction of *Ocimum sanctum* were tested

against *T. mentagrophytes, T. rubrum, M. gypseum, M. nanum, E. floccossum*. The alcoholic extract showed best activity. All the extracts of *Ocimum sanctum* inhibited *T. mentagrophytes* growth at lower concentrations (125.00 ± 25.00 µg/ml to 206.66 ± 101.03 µg/ml) [18]. Ethanolic extract of *Ixora brachiata* leaf and root completely inhibited the growth of dermatophytes with MIC 5 μgml^{-1} for leaf and 2.5 μgml^{-1}. The root and leaf are rich in starch, tannin, saponin, protein, anthraquinone, reducing sugar and glycosides [19].

Dynaria quercifolia (L) J. Smith is an epiphytic fern. Coumarins present in the ethyl acetate extract of *D. quercifolia* may be responsible for its activity against *T. mentagrophytes* says Batool Sadeghi Nejad. Its zone of inhibition is the 25mm distance at the concentration of 20 $mgml^{-1}$. Tripathy and Dixit in 1978 have reported that *Lawsonia inermis* exhibit strong toxicity where the naphthoquinones are the active factor. The chloroform extract of the plant showed activity against *T. rubrum, T. equinum, M. canis,* and *M. gypseum* and the zone of inhibition was above 20 mm [20]. Ar- turmerone, a major compound in turmeric oil has effective antidermatophytic activity against *T, rubrum, T. mentagrophytes, E. floccossum* and *M. gypseum* with MIC of 3.90 to 7.81 µg/ml [21]. The water extract, methanol, free flavonoid and bound flavonoids of three medicinal plants namely *Allium sativum*, *Cymbopogon martinii* and leaves of *Catharanthus roseus* showed activity against *T. rubrum, T. mentagrophytes,* and *M. gypseum* [22].

In a study on ringworm in animals, it has been concluded that *Aloe vera* and garlic can be used for treating ringworm infection [23]. The oil of *Curcuma domestiga* has fungicidal property and also inhibits heavy doses of inocula [24]. The activity of some Mexican plants against the dermatophytes *T. rubrum* and *T. mentagrophytes* is tested. Hexane and methanol, extract of *Annone cherimolia, Asclepa curassavica, Bixa orellana, Eupatorium aschenbornianum, Galphimia glauca, Lysiloma acapulcensis, Malva parviflora, Sedum oxypetalum, Senecio angulifolius* showed activity against *T. rubrum* and *T.* mentagrophytes [25]. The efficacy of *Trachyspermum ammi* was found to be more effective than the standard used. Based on the results of a clinical trial, it is also reported that it does not cause any skin irritation [26].

Based on the *in vitro* results of *Malaleuca alternifolia* (tea tree oil), four randomized controlled trial on patients with *Tinea pedis* was conducted. Eternal application of Tea tree oil is effective in *Tinea pedis* and onychomycosis condition says reports of the clinical trial [27, 28, 29, 30, 31]. The MIC of tea tree oil for *T. rubrum* is 1.0% v/v and for *T. mentagrophytes* is 0.3-0.4% v/v. Moreover, at higher concentrations tea tree oil act as fungicidal agent. It is believed that the major constituent responsible for this antifungal activity is terpene 4-ol [32].

Reports are available on the untoward effects of tea tree oil. It has been reported to cause allergic contact dermatitis in a few cases [33, 34, 35]. Like aqueous neem extract of *Allium, sativum* also was tested against 88 clinical isolates of dermato-phytes. 1:150 and 1:100 dilutions of aqueous extract of garlic inhibited 50% and 90% of the isolates respectively [36]. Allicin, a bioactive compound from garlic showed MIC ranging from 0.78 to 12.5 µg/ml against *T. rubrum* [37]. Clinical trials were carried out on the effectiveness of ajoene, derived from garlic in *Tinea cruris* and *Tinea corporis* [38, 39]. Seaweeds, a source of bioactive compounds are found to have action against dermatophytes at a concentration of 50 and 100 µl of chloroform, ethanol, methanol and aqueous extract. The zone of inhibition was around 5 mm to 10 mm only [40].

M. S. Ali-shtayeh reported that at a concentration of 15 μgml^{-1}, *Capparis spinosa* and *Juglans regia* completely inhibited the growth of *M. canis* and *T. violaceum*. He also had carried out his work on 20 more plant extracts [41]. Crude ethanolic extract of *Senna alata* Linn has MIC of 5.0 $mgml^{-1}$ against dermatophytes. A similar study was also carried out in Malaysia by Ibrahim and Osman 1995 [42]. A double-blind clinical trial was conducted with the leaf extracts of *Solanum chrysotrichum* [42, 43].

10% *Piper beetle* cream with 80µg of *piper betle* leaf extract was found to be effective *against M. canis, M. gypseum, T. mentagrophytes* [44]. Indurubin is an active compound isolated from *Wrightea tinctoria* R.Br. The chloroform extract of the leaf was effective against *T. rubrum* and *E. floccossum* at the concentration of 0.5 mg/ml. The MIC for *E. floccossum* is 6.25 µg/ml and for *T. rubrum, T.*

tonsurans it is 25 µg/ml. MIC for *T. mentagrophytes* and *T. simii* is 50 µg/ml.

CONCLUSION: Many antifungal agents are beyond the search of common man due to prohibitive cost so; people turn back to traditional means of treatment. The practitioners of the Siddha system of medicine have therefore to convince themselves of the safety and soundness of their medicines. It is hoped that this literature survey will help to understand that there are a large number of herbs awaiting further research regarding their anti-dermatophytic activity. Research in this area will go a long way in putting the Siddha system of medicine on scientific ground.

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